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The RxNorm Time Machine

Issues in using RxNorm for analytics

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Disclaimer

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Analytics use cases

- Example
  - Evolution of the prescription of opioid drugs over time
- Implementation
  - Claims databases (e.g., Medicare VRDC, Truven)
    - NDC ↔ RxCUI [↔ drug class]
  - Clinical data warehouses
    - [Compendia ID ↔] RxCUI [↔ drug class]
- Requires to make sense of obsolete codes
  - Obsolete NDCs mapped to current drugs
  - Identity criteria for obsolete RxCUIs (ingredient + strength + dose form)

NDCs and RxCUIs turnover rate

- NDC
  - High
  - Changes in
    - Manufacturer
    - Packaging
- RxCUI
  - Low
  - Changes in normal forms (ingredient / strength / dose form [+ QnF, QlD])
  - *Terminology updates (code changes due to editorial policies)*

E-prescribing vs. analytics

- E-prescribing
  - Restrict to currently marketed drugs
  - Restrict to drugs marketed in a given region

- Analytics
  - All drugs ever marketed
  - All drugs marketed in all regions

RxNorm

RxNorm APIs

- *Terminology updates (code changes due to editorial policies)*

RxNorm dataset (Full monthly)

- Limited support for analytics
- Obsolete RxNorm concepts and relations still present in the RxNorm dataset
  - Concepts marked obsolete
    - SUPPRESS=Y and SUPPRESS=O
  - Non-prescribable entities (unquantified forms)
    - SUPPRESS=E
- Obsolete NDCs are removed from the set of NDCs curated by RxNorm (SAB=RXNORM)
- No cumulative history metadata
  - With start and end data for each RxCUI and NDC
- Retired RxCUI data (File = RXNCUI.RRF)
  - Used as the basis for remapping RxCUIs

RxNav

- Biased towards e-prescribing
  - Until very recently
- Only active RxNorm concepts and NDCs can be retrieved
  - Support for remapped concepts
- Only active concepts can be linked to other concepts

RxNav

Secure | https://mor.nlm.nih.gov/RxNav/

NIH U.S. National Library of Medicine

About Disclaimer FAQ

mor.nlm.nih.gov says:

RXCUI = 351772 is obsolete and has been remapped to RXCUI = 1668240

OK Cancel

RxNav Navigating RxNorm Drugs

RXC

Welcome to RxNav

RxNorm Graph | RxNorm Properties | NDC | RxTerms | NDF-RT | Pill Images | Class View | Interaction View | Status

Views

- Classic
- Simple
- Table

Filters

H
V
Rx
S

Group
Form

Links

Legend

MIN
Pack
Multi

Download

IN/MIN	Ingredient	PIN	Precise Ingredient	BN	Brand Name

SCDC	Clinical Drug Component	SBDC	Branded Drug Component

RxNav Navigating RxNorm Drugs

SCD/GPCK	Clinical Drug or Pack	SBD/BPCK	Branded Drug or Pack

SCDG	Clinical Dose Form Group	DFG	Dose Form Group	SBDG	Branded Dose Form Group

RxNorm API support for analytics

- NDC
  - *getNDCStatus*(**NDC**, startDate, endDate, latest_only)
    - Indicate if an NDC is Active, Obsolete, Alien, or Unknown
      - Optionally restricted to a given time interval
    - RxNorm versions when the NDC was active
    - Original RxCUI(s) the NDC was associated with
      - All RxCUIs vs. latest RxCUI
  - *getAllHistoricalNDCs*(**RxCUI**, active_only)
    - Return all NDCs ever associated with a given RxCUI
      - Optionally restricted to active NDCs
    - RxNorm versions when the NDC was active

- *getNDCStatus*(00364666854)


```
{
    "ndcStatus": {
        "status": "Obsolete",
        "comment": "RxCUI (312656) is still active",
        "ndcHistory": [{
            "activeRxcui": "312656",
            "originalRxcui": "312656",
            "startDate": "200706",
            "endDate": "201101"
        }]
    }
}
```


312656
Promazine 50 MG/ML
Injectable Solution

- *getNDCStatus*(00143314501)


```
{
    "ndcStatus": {
        "status": "Active",
        "comment": "",
        "ndcHistory": [{
            "activeRxcui": "1116191",
            "originalRxcui": "1116191",
            "startDate": "201108",
            "endDate": "201709"
        },
        {
            "activeRxcui": "1116191",
            "originalRxcui": "198918",
            "startDate": "200706",
            "endDate": "201107"
        }]
    }
}
```


1116191
ePHEDrine sulfate 25 MG
Oral Capsule

RXCUI = 198918 is obsolete and has been remapped to RXCUI = 1116191

◆ *getAllHistoricalNDCs*(1668240)


```
{
    "historicalNdcConcept": {
        "historicalNdcTime": [{
            "status": "indirect",
            "rxcui": "351772",
            "ndcTime": [
            { "ndc": ["00069040001" ], "startDate": "201401", "endDate": "201510"},
            { "ndc": ["00069040010" ], "startDate": "201401", "endDate": "201510"},
            { "ndc": ["00069315014" ], "startDate": "200706", "endDate": "201510"},
            { "ndc": ["00069315083" ], "startDate": "200706", "endDate": "201510"},
            { "ndc": ["00069315084" ], "startDate": "201304", "endDate": "201510"},
            { "ndc": ["54569468100" ], "startDate": "200706", "endDate": "201101"},
            { "ndc": ["54868452700" ], "startDate": "200810", "endDate": "201510"},
            { "ndc": ["55154271505" ], "startDate": "200706", "endDate": "201206"},
            { "ndc": ["61947315000" ], "startDate": "200708", "endDate": "201206"},
            { "ndc": ["61947315001" ], "startDate": "200706", "endDate": "201206"},
            { "ndc": ["61947315003" ], "startDate": "200706", "endDate": "201206"}]
        },
        {
            "status": "direct",
            "rxcui": "1668240",
            "ndcTime": [
            { "ndc": ["00069040001" ], "startDate": "201511", "endDate": "201709"},
            { "ndc": ["00069040010" ], "startDate": "201511", "endDate": "201709"},
            { "ndc": ["00069315014" ], "startDate": "201511", "endDate": "201709"},
            { "ndc": ["00069315083" ], "startDate": "201511", "endDate": "201709"},
            { "ndc": ["00069315084" ], "startDate": "201511", "endDate": "201709"},
            { "ndc": ["54868452700" ], "startDate": "201511", "endDate": "201709"}]
        }]
    }
}
```


RXCUI = 351772 is obsolete and has been remapped to RXCUI = 1668240

1668240
Zithromax 500 MG Injection

RxNorm API support for analytics

- RxCUI
  - *getRxcuiStatus*(**RxCUI**)
    - Indicate if an RxCUI is Active, Alien, Quantified, Remapped, Retired, or Unknown
    - Last RxNorm versions when active (for Remapped RxCUIs)
    - RxCUI, name and type of the current active RxNorm concept
  - *RxcuiHistory**(**RxCUI**)
    - Indicate if an RxCUI is Active, Retired, Never Active, Non-RxNorm, Unknown
    - Return the canonical representation of any RxNorm concept
      - Identity: ingredient, strength, dose form (+ QnF, QlD)
      - Metadata: source, start and end date

- *getRxcuiStatus*(198918)


```
{
    "rxcuiStatus": {
        "status": "Remapped",
        "remappedDate": "110705F",
        "minConceptGroup": {
            "minConcept": [{
                "rxcui": "1116191",
                "name": "Ephedrine sulfate 25 MG Oral Capsule",
                "tty": "SCD"
            }]
        }
    }
}
```


RXCUI = 198918 is obsolete and has been remapped to RXCUI = 1116191

- *getRxcuiStatus*(1805014)

RxCUI = 1805014 has been quantified and is remapped to multiple concepts


```
{
    "rxcuiStatus": {
        "status": "Quantified",
        "remappedDate": "",
        "minConceptGroup": {
            "minConcept": [{
                "rxcui": "1805012",
                "name": "2 ML bendamustine hydrochloride 90 MG/ML Injection [Treanda]",
                "tty": "SBD"
            },
            {
                "rxcui": "1805016",
                "name": "0.5 ML bendamustine hydrochloride 90 MG/ML Injection [Treanda]",
                "tty": "SBD"
            }]
        }
    }
}
```

New RxNav support for obsolete concepts

- New Status tab in RxNav
  - Displays the canonical representation and metadata of all active and inactive RxNorm concepts
  - Powered by the *RxcuiHistory* API

RxNav
Navigating RxNorm Drugs

RXCUI 1805014

Zithromax 500 MG Injection [RxCUI = 1668240]

Active Concept

Properties

Title	Value
RxCUI	1668240
Concept Name	Azithromycin 500 MG Injection [Zithromax]
Pack Alias	
Term Type	SBD
Dose Form	Injection
Dose Form RxCUI	1649574
Multiple Ingredient	No
Branded	Yes
Quantity Factor	
Quality Distinction	
SCD	Azithromycin 500 MG Injection

Ingredients

Active Ingredient(AI) & Active Moiety(AM), as well as non-normalized numerator and denominator values, will be available in the future.

Base	AI	AM	BoSS	Numerator Value	Numerator Units	Denominator Value	Denominator Units
Azithromycin			Azithromycin	500	MG		

Metadata

Title	Value
Status	Active
Source	RXNORM
Start Date	11-2015
End Date	
Is Current	True

RxNav
Navigating RxNorm Drugs

RXCUI 857094

Acetaminophen 325 MG / Hydrocodone Bitartrate 5 MG Oral Tablet [Procet 5/325] [RxCUI = 857094]

Retired Concept

Properties

Title	Value
RxCUI	857094
Concept Name	Acetaminophen 325 MG / Hydrocodone Bitartrate 5 MG Oral Tablet [Procet 5/325]
Pack Alias	
Term Type	SBD
Dose Form	Oral Tablet
Dose Form RxCUI	317541
Multiple Ingredient	Yes
Branded	Yes
Quantity Factor	
Quality Distinction	
SCD	Acetaminophen 325 MG / Hydrocodone Bitartrate 5 MG Oral Tablet

Ingredients

Active Ingredient(AI) & Active Moiety(AM), as well as non-normalized numerator and denominator values, will be available in the future.

Base	AI	AM	BoSS	Numerator Value	Numerator Units	Denominator Value	Denominator Units
Hydrocodone			Hydrocodone Bitartrate	5	MG		
Acetaminophen			Acetaminophen	325	MG		

Metadata

Title	Value
Status	Retired
Source	RXNORM
Start Date	08-2009
End Date	02-2013
Is Current	False

RxNav
Navigating RxNorm Drugs

RXCUI 1023000

Hyperlipemia [RxCUI = 1023000]

Non-RxNorm Concept

Properties

Title	Value
RxCUI	1023000
Concept Name	Hyperlipemia
SCD	

Metadata

Title	Value
Status	Non-RxNorm
Source	NDFRT
Start Date	11-2010
End Date	09-2017
Is Current	False

Summary

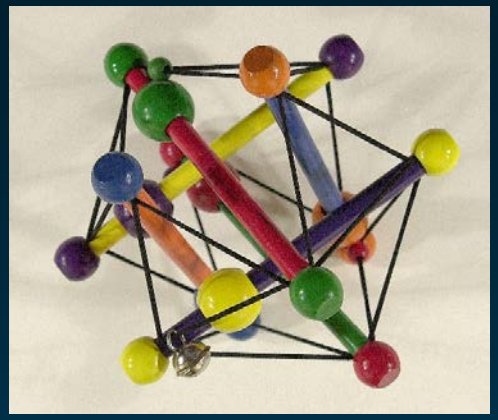
- The update model of the RxNorm dataset is biased towards e-prescribing, and does not fully support analytics
  - Obsolete NDCs are removed from the set of NDCs curated by RxNorm
  - Obsolete RxCUIs and relations persist
    - No metadata for obsolete RxCUIs

Summary

- Support for analytics ("Time Machine") built through the RxNorm API
  - NDC
    - NDC → RxCUI(s) + metadata
      - For each NDC ever curated by RxNorm
    - RxCUI → all NDCs ever associated with this RxCUI
      - Including through remapping of RxCUIs
  - RxCUI
    - RxCUI → status (including remapping)
    - RxCUI → definitional properties and metadata (for all active and obsolete RxNorm concepts)
- Displayed in RxNav (new Status tab)
- Canonical representation of RxNorm drugs
  - Can also support a similarity function for drugs

Acknowledgments

- RxNav team (development)
  - Lee Peters
  - Richard Rice
- External collaborators (use cases)
  - *getRxcuiStatus*
    - Indian Health Service
    - Value Set Authority Center
  - *getNDCStatus*
    - Boston Children's Hospital/Harvard Medical School (Dr. Ken Mandl)
  - *getAllHistoricalNDCs*, *RxcuiHistory*
    - Greater Plains Collaborative PCORnet (Dr. Jim Campbell)



Medical Ontology Research

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